# THE COUPLING

The Official News Letter of the Johannesburg Live Steam Club

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INSIDE THIS ISSUE



## From the Editor


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Editor and Secretary


A CASE FOR STANDARDS, DO WE REALLY NEED THEM?

Standards, whether it is wheel standards, boiler codes, carriage ride height or signalling standards, are they really necessary for the running of our hobby?

Well let us start at bottom and work up, and look at some basic criteria.

1. Scale and track gauge.
2. Physical and practical constraints.
3. Accessibility, Public and Members.
4. Risk to Public and Members.
5. Overall enjoyment of the hobby.

In the coming issues of this newsletter and some of our general meetings, I will be raising some very controversial issues, topics and general banter, to stimulate your thought process and make for interesting debate.

In this issue I will start the ball rolling by giving you the basic theory behind why railway wheel sets and rail are made the way they are. And why we cannot just scale down a set of works drawings, although this will no doubt open a can of worms.

### An Electronic Newsletter

Do you wish to receive your copy of the newsletter electronically? If so then drop me a line at my email address at **bradleyk@unisys.co.za**

## CALENDAR OF EVENTS

EVENT: CLUB MEETINGS

PLACE: JAMES HALL TRANSPORT MUSEUM
TIME: LAST TUESDAY OF THE MONTH @ 20H00
Monthly Gathering of Members.

EVENT: CLUB FAMILY DAYS

PLACE: THE TRACK, WEMMER PAN
TIME: LAST SUNDAY OF THE MONTH. 12H00 TO 17H00
Fun and Family day at the track grounds.

EVENT: CLUB WORKS DAY

PLACE: THE TRACK, WEMMER PAN
TIME: SATURDAY AFTER THE GENERAL MEETING 10H00 TO 15H00
Track maintenance and construction for the 1999 and 2000 steam meetings.

EVENT: SUNDAY PUBLIC RUNNING DAYS

PLACE: THE TRACK, WEMMER PAN
TIME: EVERY SUNDAY FROM 15H00 TO 17H00, WEATHER PERMITTING.
Public passenger haulage also, members and friends.

### LONG-RANGE PLANNING

EVENT: HOBBIES AND CRAFTS FAIR

PLACE: TRANSPORT MUESEM, WEMMER PAN
TIME: WEEKEND, 2 AND 3 OCTOBER 1999

EVENT: MEMBER WORKSHOP VISITS

PLACE: CONSENTING MEMBER'S WORKSHOPS
TIME: TO BE ADVISED
Monthly visits to some consenting member's workshops will be arranged

EVENT: RSME STEAM MEET

PLACE: LEN RUTTER PARK
TIME: 24TH TO 26TH SEPTEMBER 99
National Steam Meet held at the grounds of the Ran Society of Model Engineers, valid Boiler Certificates and drivers licenses are required by visiting locomotives and drivers.

## RAILROAD WHEELS AND TRACK, A GEOMETRIC LOOK.

Based on articles by Christopher A. Lee and Christopher Coleman

When a car, truck or any body with adjacent wheels goes around a curve, the outside wheels have further to travel than the inside wheels. This problem has been solved by the use of a differential rather than a solid axle in the case of motor cars. In the case of railroads however, a solid axle is necessary for strength and simplicity, so our railway grandfathers had to apply ingenious means to keep trains on track.

The treads of a railroad wheel are not flat, but are in the shape of a hyperbole (a sort of curved cone). That is with the smaller diameter toward the outside and the curve leading into the flange. The distance between the inside faces of the wheel is slightly larger than the distance between the outside faces of the wheel flanges by about an inch. So as one of the wheels rides up its rail, the other wheel rides down its rail. The different diameters in contact with the rail have different circumferences, which compensates for the different distances of travel.

Rail and Wheel cross-section

**Contrary to popular belief, the flanges do not keep the wheels on track, they are there only as a last resort to keep the wheels on the track, what keeps the wheels on track really is a combination of factors.**

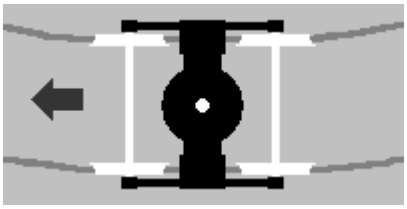
First let's discuss what keeps the car on the tracks. The force pulling the car into the curve is the Centripetal Force, the generic name for the net force that pulls a object in an arc. The components of this Centripetal force are:

- The preceding and following cars through the couplers.
- The frictional force between the wheel treads and the railhead.
- Gravitational force IF the track is super-elevated (banked). This force tends to counteract the inertia, but since it is applied to the lower quarter of the car, the result is a torque on the car around the centre of gravity (COG), tending to rotate it towards rolling out of the curve. More important to use here, it also effects the centring action by pushing the trucks toward the inside of the curve relative to the car's centre of gravity


Forces on a Railcar - End View

Now inertia and the centripetal Force counteract to prevent the car from flying off the inside or outside of the track, but what keeps the flanges from hitting the rail?

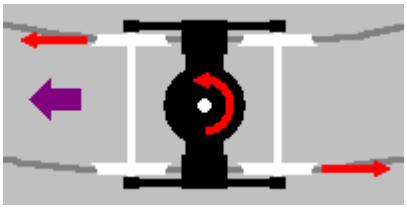
Now consider the trucks as a separate system from the rest of the car. A state of equilibrium exists at a point where the circumference of each wheel, where it contacts the rail, matches the distance it needs to travel in one revolution.



Truck in Equilibrium - Top View

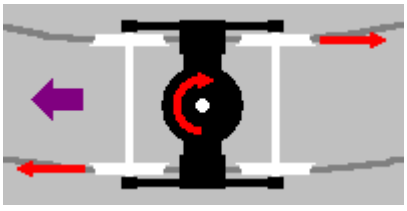
Prior to reaching equilibrium the outer wheel is climbing the outer rail, and we will call this state Under-compensation. Until it reaches that point, there is a drag force (against the direction of travel) on the outer wheel as where it is being forced by the inner wheel to rotate too slowly to cover the distance it must travel. Similarly the outer wheel is forcing the inner wheel to rotate too fast causing a traction force (in the direction of travel). These forces exert a torque on the truck around a vertical axis at its connection to the car. This torque pushes the lead outer wheel higher on the rail (giving it a larger diameter) and the lead inner wheel lower (giving it a smaller diameter).

The trailing wheels tend to follow the path of the lead wheels forcing the system toward the equilibrium point.



Truck in under compensation - Top View

Now these forces, and hence the torque, are zero at the equilibrium point, but the forces prior to equilibrium may be great enough to cause an overshoot, and we will call this state Overcompensation. When this happens or when the car is leaving the curve, the diameter of the inner wheel is now too small and is dragging and that of the outer is too large causing a tractive force. The forces are now reversed and exert a torque in the reverse direction that causes the leading outer wheel lower on the rail (giving it a smaller diameter) and the leading inner wheel up on the rail (giving it a larger diameter). This again forces the system back toward the equilibrium point.



Truck in Overcompensation - Top View

The slightest Overcompensation would cause a oscillation between these two states if there was not lateral friction between the rail and the wheel. So in this way the trucks find their way to the equilibrium point. The exact location of the equilibrium point depends on the forces acting on the system, especially gravity, the Centripetal force, and the geometry of the track.

This centring action does not always work well enough. If you observe a heavily loaded or fast moving train on a curve, you will hear a periodic squeak or long squeal. This results from the Over

compensation to the extent that the wheel flange bumps the rail head (squeak) or slides along it for a time (squeal), until the centring action takes it back towards equilibrium. This can also be exaggerated by bad track (crowned sectional rail for example) which forces the wheels back and forth.

## South African Railways Class 26 rides again

**Extracted from the 'Friends of the Rail' Internet site**

I took a leisurely Sunday afternoon drive to De Aar last Sunday (6 June). Popped into Beaconsfield shed on the way to find 3450 simmering at the coal stage, gleaming red in the setting sun. The Red Devil was looking good, brass and copper polished up nicely, a fresh coat of paint and nice & clean. The loco is not lined with white any more, and now carries "Red Devil" deflector plates and THF numberplates. The "No." and "3450" plates from the buffer beam are no longer there. The wheels are red with black tyres. The cab was immaculate, all the gauges, handles, spindles etc. gleaming brass, and a nice thick fire burning on the grate. There is still exhaust steam being piped in beneath the grate, couldn't see if standard or pinhole grates are in, nor what type of blast pipes were installed. Apparently it has a standard 25NC superheater header now rather than the larger GMAM model fitted originally. 5 leaking washout plugs were noticed on closer inspection but otherwise the loco looked great.

Drove on to a chilly De Aar, via the railway route. Had a few run pasts along the way (a few buck running past the car!), narrowly avoiding a hard meeting with a springbok (?) leaping across the road near Behrshoek. A couple of trains seen near Kimberley, but all else quiet. I spent the night at the Hydra Guesthouse, which is a group of ex-Eskom houses now being used as accommodation. I had an entire 3-bedroom house to myself for R60, highly recommended!

Driving into De Aar on Monday morning, I could see huge clouds of steam rising from the loco shed area. The Red Devil had been brought down light engine overnight, and was blowing down, creating huge clouds of steam. The rails were coated in ice, the loco cab was the only place to be! A few other chilly gricers were taking some night shots as well. The train was due out at 7:05, so we headed up towards Behrshoek. Trying to judge where the train would be at sunrise was tricky, not helped by the fact that the train appeared to have left early. We set up between Behrshoek and Perdevlei and waited...

3 degrees below zero, air clear and still, not a cloud to be seen, just minutes before sunrise. A steam plume appears on the distant veld, racing along the flat. Soon, the exhaust of a hard working loco echo from the hills, the steam plume expands. An exchange of whistles as another train is passed, exhaust sound growing louder and faster. The headlight shines from around the curve, the loco barking

its imminent passing to the empty Karoo. The sun crests the horizon, the train approaches, and there it is... The Red Devil, staccato exhaust creating huge plumes of sculpted steam, hanging in the freezing air, tinged gold by the rising sun. And with a rush of noise, wind and flailing side rods, the machine has passed, the harsh bark fading into the comparatively soft whisper of the coaches following dutifully behind. Then it's gone, the smell of coal smoke lingers, the steam cloud slowly dissipates, and the Karoo continues waking from its cold slumber...

Got a bit carried away there, but it was a great way to see the sun rise! A run past (or run forward rather) was held at Behrshoek, the train inspector wouldn't allow the train to push back, so the passengers had to walk ahead and the train then moved past. Another run past at Houtkraal, then a speedy run up towards Potfontein. It was a gricing scene from days of yore – rail fans speeding along the dirt road, chasing a Red Devil in full cry, trying to get far enough ahead for the next shot. There were some interesting displays of rail fan driving as well. A gent from the UK in a hired Golf was stuck at Houtkraal, the positive lead had come loose off the battery. A little later the same car was seen sliding around a corner in an interesting manner. It takes quite a lot of practice to master the art of keeping the car on the road at 120km/h, driving through thick dust, taking the curves on loose gravel, changing film and trying to look at the Red Devil as you drive alongside! The true masters can also take video of the loco pacing at the same time.

A couple of shots later and we took to the service road from Kraankuil to Orange River. This road was even better (?) than the main road. We had no chance of catching the train before Orange River, but we hurried nonetheless. Where the farm roads cross the track, the service roads cross the embankments at right angles. I glanced in my mirror to see the Golf behind me launch into the air in true rally style. How he kept control of the landing is beyond me! A little further on, water had carved a nice deep channel in the road - again cars all over the place! I saw that the Golf arrived at Orange River minus a hubcap and part of the front spoiler. Mr. Avis will be happy! The road was too much for Tony Attwell's tyre, so he and Jean pulled out of the race for quick repairs...

A pause at Orange River to take water and clean fire, then another 20 minutes or so while a diesel freight passed and cleared the section. A false start was made for the passengers. Shots were taken at Orange River Cutting, Enslin and one or two in-between places before missing the train totally at Beaconsfield South!

A trip to the shed found 3300 at the coal stage, ready to go. SteamNet 2000's locomotives were looking clean and painted. 3467, 3441 and another NC "Anne" (no number), plus a class 11, and a big surprise was the NRZ 15A class #398 - when did this loco arrive in South Africa? I believe the 15's are out of the SAR loading gauge...

A quick fill up of petrol and film followed, and while waiting near Kimberley for the 23, David Benn noticed that my front tyre was also the worse for wear after the rugged roads. A quick change (thanks for the assistance guys - much appreciated!), and the next stop was Perdeberg. We couldn't find the way in to the S-curves there as the roads have changed, and a guy on a tractor had dug the service road up not 10 minutes before. They were laying cable or something. So we went for second prize, the bridge over the Modder River. The 23 eventually arrived, got some shots of it on the bridge, then the train stopped and disgorged all the passengers for a run past. We dashed to the other side of the river for another shot. No smoke but pleasant enough.
Further shots were at Immigrant, Petrusburg then De Brug, where a water stop was made. The sun was dipping low as the train left De Brug, giving a strong glint, then the final shot was at Driekloof, seconds before the sun turned in, another passable glint, although the smoke drifting in front of the sun dulled the golden light somewhat...
Altogether a good day, a bit long after finally arriving back in Pretoria at 10:00 p.m. Round trip was a total of around 1800-km

## Class 26 Specifications

| Class | Cylinder bore & Stroke | Driving Wheel Diameter | Boiler Pressure | Tractive Effort | Weight Engine (working) | Weight Tender (working) | Total Length over Couplers | Grate Area | Max Axle Load |
|---|---|---|---|---|---|---|---|---|---|
| 26 | 24"x28" | 5 ft | 225 lbs. per sq. in | 68040 lbs. | 117t 9cwt | 105t 11cwt | 27.9035m [91' 6 9/16"] | 70 sq. ft. | 18t 14cwt |

## A Question of Scale

Let us talk for a moment on the issue of gauge and scale. That which I am about to discuss, is with out a doubt, old hat to some of our older members, but is none the less relevant and might be of interest to our younger members.

Before we even jump into the question of scale size let us look to where the typical prototypes of the models come from,

- English locomotives of 4' 8 1/2" STD gauge.
- SAR locomotives of 3' 6" STD gauge.
- Other locomotives of 5' 6" gauge, 2' 6"gauge,
- 2' 0" gauge and meter gauge.

The model engineering fraternities in the majority of the world has adopted track gauges from the UK and they are as follows: -

- 2 1/2" World Standard
- 3 1/2" World Standard
- 4 3/8" North American
- 5" World (Some American States)
- 7 1/4" World (Some American States)
- 7 1/2" American

The scale to which you build your models to is determined by which prototype locomotive you choose and on what gauge track you wish to run, and if you wish to model fine scale or narrow gauge models (Question: Is SAR 3' 6" gauge classified as NARROW gauge? According to the Beyer Peacock locomotive works, Yes)

Why is this important you ask? Well if you take the popular SCALE factors we build to, i.e.

- 3/4 inch to the foot
- 1 inch to the foot
- 1.5 / 1.6 inch to the foot
- 2 inch to the foot
- 4 inch to the foot and
- inch to the foot

Now when we put all of this into practice we can end up with some very large locomotives. For instance, take a British built "West Country Class 4-6-2" running on 4' 8 1/2" gauge track and compare it to the German built SAR "16E 4-6-2" running on 3' 6" gauge track. Both are of comparable size, but run on two different gauge tracks.

Applying the model track GAUGE as a factor of scale, if we build both of these locomotives to run on 3 1/2" gauge track then the British loco would be some 25% smaller than the SAR one. This is because for the British loco to run on 3 1/2" gauge it would be built to a SCALE of 3/4" to the foot and the SAR loco built to 1" to the foot. Conversely if we build to SCALE, (1" to the foot) then the SAR locomotive would run on 3 1/2" track and the British locomotive would run on 5" gauge and both would be of comparable size.

Now let us look at this logically, A prototypical 3ft 6in gauge locomotive might have a component dimension of 6 inches, a NG 2 foot locomotive might have common component dimensions, we now scale these dimensions down to fit our 5 inch gauge track and get the following: -

6 inch = 0.5' x 1.5 = 0.75 inches for 3ft 6in South African Std

6 inch = 0.5' x 4 = 2 inches for 2ft NG

Now taking this one step further, people also build British 4ft 8 ½ in gauge Prototype locomotives that we build to 1in scale and for the same component dimension above, we will get…

6 inch = 0.5' x 1 = 0.5 inches for 4ft 8.5in British Std.

As you can see we have a dilemma here, if we had to build a scale tunnel for our British standard scale locomotive running on our 5in gauge track, we would never get our SAR 1.5in scale locomotive to go through it, as it is 50% larger. The 2ft NG locomotive is even larger.

This makes for interesting problems and impracticalities when designing track work and rolling stock for multiple gauge tracks, and the main reason why we have STANDARDS for the GAUGE and not for the SCALE.

As you can see the question of which gauge to run on is just as confusing as in what scale to build to.